NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

PUMPING PLANT FOR WATER CONTROL, (NUMBER)

Code 533

DEFINITION

A pumping facility installed to transfer water for a conservation need.

PURPOSE

Provide a dependable water source or disposal facility for water management.

CONDITIONS WHERE PRACTICE APPLIES

Wherever water must be pumped to accomplish a conservation objective, which may include, but is not limited to one of the following:

- To provide a water supply for such purposes as irrigation, recreation, livestock, or wildlife.
- To maintain critical water levels in swamps, marshes, open water, or for newly constructed wetlands and ponds.
- To transfer wastewater for utilization as part of a waste management system.
- To provide drainage by the removal of surface runoff water or groundwater for drainage or flood control purposes.

CRITERIA

GENERAL CRITERIA APPLICABLE TO ALL PURPOSES

Design, installation, and operation of a pumping plant shall comply with all federal, state, and local laws, rules and regulations.

The efficiency of units, type of power, quality of building, automation features, and other accessories installed shall be in keeping with the economic and environmental value of the system to accomplish the conservation objectives.

Criteria for the design of components not addressed in NRCS practice standards shall be consistent with sound engineering principles.

GENERAL

An adequate outlet must be available for pumping plants intended to dispose of excess water. An adequate source of water must be available for pumping plants that will supply water to a deficient area. The area to be benefited by pumping must be protected from damaging floods or excess water. Diversions, dikes, or ditches may be required for an efficient installation. A bypass should be used to discharge as much water as possible by gravity in order to reduce the volume of water to be pumped. All disposal of water shall be in compliance with Iowa Drainage Laws.

Pump Requirements. Capabilities, range of operating heads, and general class and efficiency of equipment shall be determined by appropriate technical means. Size and number of pumps and their performance shall be determined based on system conservation requirements in order to meet the intended purpose. Total head shall be determined for critical operating conditions, taking into account all hydraulic losses. Automatic controls shall be included as required.

Pumps utilized for the transfer of wastewater or manure shall be sized to transfer material at the required system head and flow rate determined by the waste management plan. The pump type shall be based on the consistency of material being pumped and manufacturer's recommendations.

Power Units. Power units shall be selected based on availability of fuel or power, costs, operating conditions, conservation needs, and objectives, including the need for automation. The power unit shall be matched to the pump and be capable of operating the pump efficiently and effectively within the range of operating conditions. The horsepower requirements, pump efficiency, and total head on the pump shall be computed.

Suction and Discharge Pipes. The size of suction and discharge pipes shall be based on a hydraulic analysis, operating cost, and compatibility with other system components. The arrangement and length of discharge pipe shall be based on the need for recovery of head through siphoning action, and for delivery of water in keeping with conservation and environmental objectives.

Gates, valves, pipe connections, discharge bays, and other protective devices shall be installed, as needed, for satisfactory pumping plant operation.

Federal, state, and local laws and regulations concerning back flow prevention shall be followed when pumping from wells.

Building and Accessories. The design of the pumping plant and associated housing, if required, shall consider accessibility for equipment maintenance and repairs, and the need for protecting equipment from the elements, vandalism, and fire. The appearance of the plant shall be compatible with the surrounding environment, as applicable.

Foundations shall be designed to safely support the loads imposed. Sheet piling or other measures shall be used, as required, to prevent piping beneath the foundation.

Pumps may be mounted in the open, on piling or concrete foundations, in a well or pit, or by other appropriate means.

Suction bays (or sumps) shall be designed to conform to the hydraulic characteristics established by the pump manufacturer.

The discharge bay or connection with the distribution system shall meet hydraulic and structural requirements. Provisions for repair or removal of pumps and engines shall be provided. Trash racks shall be provided, as needed, to exclude debris and trash from the pump.

All structural features and equipment shall provide adequate safety features to protect workers and the public from injury.

TILE DRAINAGE

Closed Sump - For Tile Flow Only

Pumping Plant Capacity. The minimum capacity will be as required for a tile main in Subsurface Drain (606) plus a reasonable allowance for periods when the tile system will be flowing at a rate which is higher than the design discharge. (This allowance shall have a minimum value of 10% and may be as high as 50% depending on soils, land slope, and tile system characteristics).

Pump Type. The type used should be efficient (50% or more) for static heads of five to ten feet. Propeller type (axial flow or mixed flow) pumps are usually best suited for this type operation. The pump(s) should have a capacity, which is equal to the expected design discharge of the collection system. Pump capacity will be figured at a static head, which is measured from the centerline of the lowest tile line to the centerline of the pump discharge or expected tailwater (whichever is higher).

Drainage coefficient converted to gallons per minute for pump capacity:

GPM = Drainage coefficient x watershed acres x 0.042 x 448.8

where (0.042 cfs/Acre = 1 inch runoff in 24 hours and 1.0 cfs = 448.8 gallons per minute)

Operation. A regular service pump will have automatic controls which will allow the pump to operate between established levels (start and stop). The pump will start whenever water in the sump reaches the lowest tile invert and stop before the pump sucks air.

This will normally require that the pump be powered by an electric motor and the motor will be controlled by a float or electrode switch. (A difference in elevation between start and stop levels of one to three feet is normally used). A supplementary pump which is used only once or twice a year to supplement the regular service pump may be tractor powered. This type of installation is most applicable where the pumping plant handles surface runoff as well as subsurface runoff.

Discharge Pipe for pumps shall be watertight and of sufficient size to keep friction losses to a practical minimum. Flap gates should be provided wherever the tailwater will submerge the outlet.

Storage. Temporary storage must be provided either within the sump or outside the sump to prevent the pump from starting and stopping (cycling) too frequently. Maximum cycling will occur when the inflow to the sump equals one-half the capacity of the pump operating at the average static head. A well designed pump should not cycle more than 10 times per hour. Some of the less efficient pumps should not be permitted to cycle more than five times per hour. To calculate the storage volume required, use the following formula:

$S = AD = \frac{2P}{N}$ where:

S = Storage volume in cubic feet
P = Average pump capacity in gpm*
N = Maximum permissible cycles per hour
A = Storage area in sq. ft.
D = Storage depth in feet (from start level to stop level)

*If more than one pump is used, pump capacity for only one pump need be used. This would be for the pump that is going to handle subsurface flow.

Where storage is within the sump, a storage depth of two feet is usually used. For ditch storage one foot is common.

Sump. The sump should be made of durable materials and be structurally sound for the loads to which it will be subjected. Sumps that are essentially watertight will be checked for flotation and uplift pressures. The sump will serve as an intake bay or basin for the pump and will also be adequate for temporary storage on the average farm job. Pump manufacturer's recommendations for clearance and submergence should be followed in sump design. The stop level should be set to provide the minimum submergence depth recommended by the manufacturer. Where sand is encountered, a concrete floor or riprap shall be required in the sump.

Sump Inlet. Tile emptying into the sump shall outlet through a minimum eight-foot length of continuous pipe.

Open Sump - For Tile Flow Only

The requirements of a pump drainage system with open sump (ditch or pit type) are similar to the closed sump system except as follows:

The sump shall be excavated to provide the required storage. One foot of storage depth is common. Side slopes, berm, and spoil banks will comply with Drainage Main or Lateral (480).

A structure shall be provided upon which to mount the pump. This may be beams that span the open sump, piling and necessary support members in the sump, or a small separate cistern type sump connected to the main sump by means of a culvert. If the latter system is used, the connecting culvert shall have a capacity at least equal to the maximum pump discharge. Necessary clearance and submergence should be provided as recommended by pump manufacturer. It should be constructed of durable materials and be structurally sound for the loads it will be subjected to. Where sand is encountered, a concrete floor or riprap shall be required in the immediate area of the sump intake.

If the structure is located within the sump, cribbing to allow for pump submergence and clearance need only be provided to the elevation of floor of the sump.

If the bay (structure from which the pump withdraws its water) is located outside the sump, cribbing must be provided to adjacent ground level.

When an open sump is used, a screen shall be provided for the pump.

Tile emptying into the sump shall outlet through a minimum 16-foot length of continuous pipe.

OPEN DITCH DRAINAGE

The requirements for a plant which will provide an outlet for Drainage Mains and Laterals will be essentially the same as specified for "open sump" except:

Minimum Total Design Capacity for the pumping plant will be as specified in Table 1.

Table 1

Drainage Area To Pumping Plant Acres	Gallons Per Minute Per Acre	Drainage Coefficient
0-100	18.8	1”
100-500	16.4	7/8”
500-1,000	14.1	¾”
Over 1,000	9.4	½”

Consideration will be given to providing additional capacity depending on crops to be grown, soils, seepage flow, and topography of the area.

Pump Capacity will be determined at a static head which is measured from the highest permissible elevation of the hydraulic grade line in the open channel immediately upstream from the pumping plant to centerline of the pump discharge pipe or expected tailwater (whichever is higher).

Automatic Operation is desirable but not required. The pump should be capable of drawing the water level in the open sump down to a level, which will provide a free outlet for all tile. If there are no tile anticipated, the pump should be capable of pumping the sump essentially dry.

Storage. For manual operation the number of starts should be limited to two per day. The volume of storage in cubic feet required below the hydraulic grade line in the open sump may be approximated by multiplying the pump capacity in gallons per minute times 25. If tile is involved, the hydraulic grade line will be considered to be at the

Screen. A screen will normally be required to keep harmful debris out of the pump.

CONSIDERATIONS

When planning this practice the following items should be considered, as applicable:

- Effects on downstream flows or aquifer recharge volumes.
- Effects on existing wetland hydrology.
- Effects on surface and ground water by leaked or spilled fuels and lubricants.
- Secondary containment of spilled fuel for water quality as may be required by federal and state laws or regulations.
- Protection of system components from “natural” events such as floods.

PLANS AND SPECIFICATIONS

Plans and specifications for constructing pumping plants shall comply with this standard and describe the requirements for properly installing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An Operation and Maintenance plan specific to the facilities installed shall be prepared for use by the landowner or responsible operator. The plan shall provide specific instructions for operating and maintaining facilities to ensure the pumping plant functions properly. The plan shall include provisions to address the following, as a minimum:

- Inspection or testing of all pumping plant components and appurtenances, as applicable.
- Proper start-up procedures for the operation of the pumping plant.
- Routine maintenance of all mechanical components (power unit, pump, drive train, etc.) in accordance with the manufacturer's recommendations.
- When applicable, the power unit, fuel storage facilities and fuel lines should be frequently checked for fuel or lubricant leaks and repaired as needed.
- Periodic checks and removal of debris as necessary from trash racks and structures to assure adequate capacity reaches the pumping plant.
- Periodic removal of sediment in suction bays to maintain design capacity and efficiency.
- Inspect and maintain anti-siphon devices, if applicable.
- Routinely test and inspect all automation components of the pumping plant to assure they are functioning as designed.
- Inspect and maintain secondary containment facilities, if applicable.
- Periodic inspection of all safety features to ensure they are in place and functional.
- Prior to retrofitting any electrically powered equipment, electrical service must be disconnected and the absence of stray electrical current verified.